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THE OCCURRENCE OF *PARACOENOGONIMUS OVATUS* (TREMATODA, CYATHOCOTYLIDAE) IN FISH OF NATURAL RESERVOIRS OF MYKOLAIV REGION

S. L. Goncharov[1], N. M. Soroka[2]

[1]*Mykolaiv Regional State Laboratory of Veterinary Medicine,*
Lunacharsky, 2 A st., Mykolayiv, 5400 Ukraine
E-mail: sergeyvet85@ukr.net
[2]*National University of Life and Environmental Sciences of Ukraine,*
Polkovnyka Potekhina, 16 st., Kyiv, 03030 Ukraine

The Occurrence of *Paracoenogonimus ovatus* (Trematoda, Cyathocotylidae) in Fish of Natural Reservoirs of Mykolaiv Region. Goncharov, S. L., Soroka, N. M. — The article presents the original findings of *Paracoenogonimus ovatus* (Katsurada,1914) in fish in the Southern Bug and the Inhul rivers in Mykolaiv Region in 2012–2014. The roach (*Rutilus rutilus*), silver bream (*Blicca bjoerkna*), bream (*Abramis brama*), crucian (*Carassius gibelio*), rudd (*Scardinius erythrophthalmus*), pike (*Esox lucius*), pikeperch (*Sander lucioperca*) were found to be infected with metacercariae of *P. ovatus*. Metacercariae of *P. ovatus* are described based on the original material. The highest prevalence of infection was observed in the roach, 82.3 %, the pike was infected in the less degree, with prevalence of 15.3 %. The infection intensity was highest in the roach, up to 247 specimens; that of the pikeperch was the lowest — 17 specimens. The highest occurrence of *P. ovatus* was observed in the parts of the river Southern Bug in Zhovtnevy, Mykolaiv, Novoodesky Districts, whereas in Voznesenky, Pervomaysky Discticts and in the city of Mykolaiv the occurrence was the lowest. In the area of the river Inhul the parasite was observed mostly in the waters of Bashtansky District in Mykolaiv Region.

Key words: occurrence, *Paracoenogonimus ovatus*, fish, intensity of infection, extensity of infection, natural reservoir, Mykolaiv Region.

Распостранение параценогонимоза (Trematoda, Cyathocotylidae) в природных водоемах Николаевской области. Гончаров С. Л., Сорока Н. М. — В статье приведены данные распространения в акваториях рек Южный Буг и Ингул относительно нового, трематодозного паразитарного заболевания рыб — параценогонимоза, которое ранее на территории Николаевской области не регистрировалось. Исследования проводили в 2012–2014 гг. Приведены исторические факты изучения трематоды *P. ovatus.* Установлена инвазированость метацеркариями *P. ovatus* различной степени таких видов рыб, как тарань, густера, лещ, карась, красноперка, щука, судак. Наиболее пораженной была тарань, экстенсивность инвазии составила 82,3 %, наименее инвазированым оказался судак, экстенсивность инвазии которого составила 15,3 %. Интенсивность инвазии была максимальной у тарани — 247 экз., и наименьшей у судака — 17 экз. Наибольшее распространение отмечено на участках реки Южный Буг в Октябрьском, Николаевском, Новоодесском районах, в меньшей степени отмечено в Вознесенском, Первомайском районах и г. Николаеве. На участке реки Ингул концентрация инвазии наблюдалась преимущественно в акваториях Баштанского района Николаевской области.

Ключевые слова: распространение, *Paracoenogonimus ovatus*, рыба, интенсивность инвазии, экстенсивность инвазии, естественный водоем, Николаевская область.

Many infection agents, previously considered as safe and, therefore, poorly studied, are rather pathogenic in modern industrial fish farming and can yield significant economic losses. Accordingly, they require urgent examination (Mineeva, 2013). Fish raised in pond farms (carp, common carp, grass carp, silver carp, etc.) are mostly free from larval helminthes pathogenic for humans and animals. On the contrary, commercial fish, mollusks, crustaceans are potential carriers of 27 species of helminthes that are dangerous to humans (Davidov, 2003). Fisheries established in natural reservoirs (lakes, rivers, ponds) also require investigation of parasitic diseases of fish. However, their control in these reservoirs is limited. The knowledge of the biology and the spread of pathogenic parasitic infections contribute to the development of effective control techniques resulting in the improvement of epizootic status of fish stock and the reservoir itself (Bauer, 1984). Trematodoses may cause significant economic losses because of death of fish or its poor salable condition for both domestic and foreign fish market (Ginetsinskaya, 1959). Trematode *P. ovatus* belongs to pathogenic agents that pose a potential threat to fish and human health.

Paracoenogonimus ovatus parasitizes the intestine of piscivorous birds, mammals, sea mammals and humans (Sudarikov, 2006). Metacercariae inhabit mainly fish muscular tissue. They can also be found in the fins, heart, gills, liver, kidney, ovary, vitreous body of the eye and brain, but much less frequently (Ginetsinskaya, 1959).

Metacercariaeof *P. ovatus* are highlypathogenic for fish larvae; they can reach intensity of up to several thousand specimens and, therefore, may be dangerous for mammals consuming infested fish (Ginetsinskaya, 1959; Linnik, 1988).The extreme spread of the parasite was spotted in reservoirs of Russia, Poland, Germany, the Netherlands, Romania, Hungary, Finland, Latvia, Norway, Azerbaijan, Czech Republic, Slovakia, Belarus, etc. (Davidov, 2003; Komiya, 1938). According to the results of research, the disease is most common both in-natural and in artificial reservoirs in Russia (Ginetsinskaya, 1959).

At the same time, there are no data on the distribution of *P. ovatus* on the territory of Ukraine.

F. Katsurada (1914) first described a new species of trematodes, *P. ovatus*, which he isolated from the gastrointestinal tract of the laboratory mice infected with metacercariae from the muscular tissue of carp caught in the Elbe and the Alster rivers in Germany. There after, this species was described by L. Szidat during the examination of birds of the Baltic Sea (Szidat, 1936). J. Komiya studied the parasite's life cycle, and first pointed to the possible intermediate and final hosts of *P. ovatus* (Komiya, 1938).

In Ukraine, *P. ovatus* was first described by Markevich in 1951 in the mouths of the Dnieper and the Tiszaunder the name of *Diplostomulum hughesi* Markevitch, 1934. Metacercariae were found in the muscular tissue of pike (*Esox lucius*) (Markewitch, 1951). On the territory of the former USSR, the species was investigated by T. Ginetsinskaya, whose major scientific interest was to determine the systematic position and taxonomic affiliation of this species based on morphological characteristics. The author also studied the clinical manifestations of paracoenogonimosis and noted that the processes of infiltration and migration were accompanied by multiple hemorrhages, which likely caused rapid (within a few hours) death of infected fry. In the author's opinion, the formation of metacercariae lasted 30 days, with metacercariae being placed in spherical cysts with transparent hyaline membrane. The cysts had an average size of 0.376 mm (Ginetsinskaya, 1959). J. Komiya made an assumption that mollusks *Viviparus viviparous* and *Viviparus contectus* were involved into the life cycle of *P. ovatus* (Komiya, 1938). At the same time, according to O. Serbina, parthenits of *P. ovatus* were found in *Bithynia tentaculata* from the Upper Ob in Western Siberia (Serbina, 2002). Carp, gobies, salmon, pike, herring, silverside, stickleback and even Syngnathidae were reported as hosts of *P. ovatus* (Sudarikov, 2006).

The aim of our study was to examine natural reservoirs of the Southern Bug and the Inhul rivers in Mykolayiv Region, to reveal *P. ovatus*and to determine possible causes of its spread.

Material and methods

We collected fish during the planned probing catches in the reservoirs of the river Southern Bug (Zhovtnevy, Mykolaiv, Novoodesky, Voznesensky, Pervomajsky Districts and the city of Mykolaiv) and the Inhul (Bashtansky and Mykolaiv Districts), in Mykolaiv administrative region. Fish were caught with fishing lines or purchased from fishermen on the catching plots. All fish specimens weighting more than 50 g were subjected to ichthyopathological examination. Autopsy and clinical studies were performed by conventional methods (Bikhovskaya-Pavlovskaya, 1985).

During 2012–2014 1258 specimens of various fish species have been examined. Fish tissues were collected and examined using the compressor MIS-7. Microscopy was performed using trinocular microscopes Micromed XS-4130 and binocular stereoscopic microscope Micromed X-6320. Metacercariae were detected in the muscular tissue of fish of different species.

Results and discussion

Neither pathological nor behavioral changes were observed in selected samples of the roach (*Rutilus rutilus*), silver bream (*Blicca bjoerkna*), bream (*Abramis brama*), crucian (*Carassius gibelio)*, rudd (*Scardinius erythrophthalmus*), pike (*Esox lucius*), pikeperch

(*Sander lucioperca*). No harmful organisms except parasitic associations were found by the microscopy of scrapings from the skin and gilllobes of the fish. Pathological changes of the internal were not identified, and muscle tissue also did not demonstrate any changes. We believe this is due to the fact that the peak offish infection and cercaria migration in fish tissue, as well as the formation of metacercariae is seasonal.

We did not find metacerkariae during the microscopy of hepatopancreas, gall bladder, eye lens, tissues of the heart, kidneys and brain. The metacercariae of *P. ovatus* were found in muscular tissue taken from different parts of fish body. The internal structure of the larvae located in the cystis characterized by a typical pattern, which is a «T-joint»in the ring with three narrow slits. This shape is formed by the channels of excretory system. These channels are filled with excretory granules that strongly refract the light, so that they seem to be black. Larva in the cyst was sedentary and moved only at squeezing in between the glass. It could be also observed that the bulk of excretory granules in moving larvae concentrated or spread. Under higher temperature, larva showed active motor activity. During the motion, oral sucker was well visualized. The larva was folded in two. The cyst size was 0.38–0.41mm (n = 21) (fig. 1).

In some cases, we detected the cysts with disrupt content, alive metacerkariae were located nearby (fig. 2).

Some cysts selected from the pike had a clear polarity of the outer shell. According to some publications, such cysts are found at low infection degree (Linnik, 1988). For example, those cysts collected from the silver carp (*Carassius gibelio*), had no similar polarity and cysts had a spherical shape (fig. 3).

Metacercariae are egg-shaped and reach 0.47–0.57 mm length and width of 0.39–0.41mm (fig. 4).The body of metacercaria is covered with spines. Oral sucker is 0.049–0.072 mm in diameter, pre-pharynx is short. Muscular, ball-shaped pharynx is

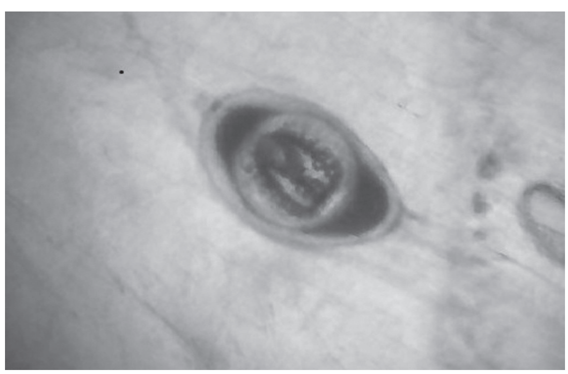


Fig. 1. Metacercaria of *P. ovatus* from the pike.

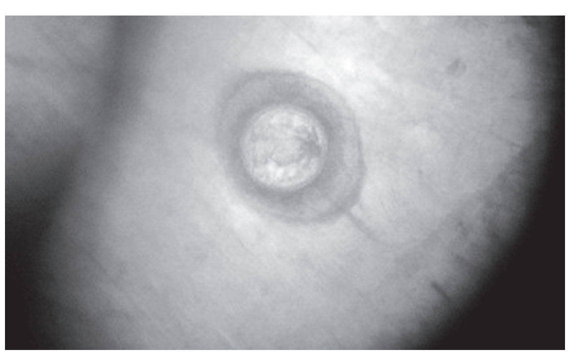


Fig. 2. A cyst with disrupt content from the bream.

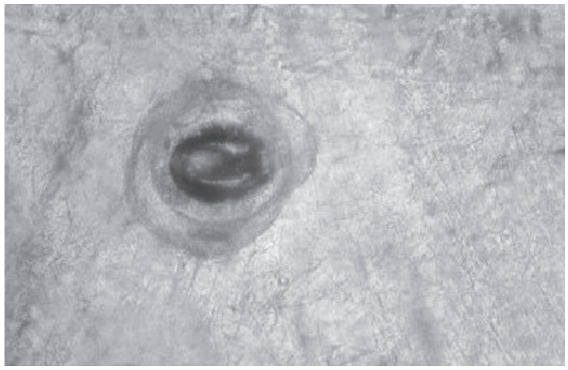


Fig. 3. Metacercaria of *P. ovatus* fromthe silver carp.

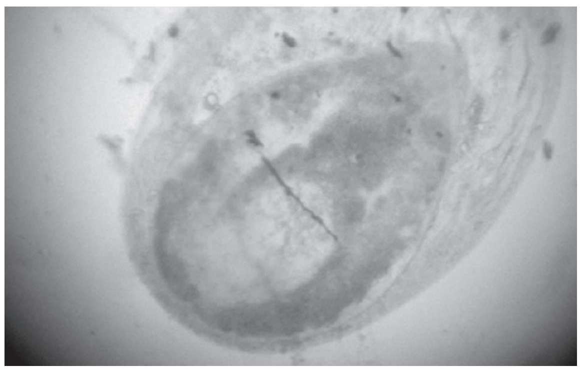


Fig. 4. Larva of *P. ovatus* from the pike.

0.037–0.04 mm in diameter. The length of the esophaguss lightly exceeds the diameter of the pharynx. Ventral sucker is underdeveloped, it is smaller than pharynx and has a diameter of 0.031–0.048 mm. Brandes organ is 0.09–0.1mm in diameter, it is relatively large, has a cavity with a small slot-like hole. Primordia of the genital system are located posteriorly. A small ventral concavity is present. Caudal appendage has a small bulge on the posterior end of the body.

P. ovatus infection was often accompanied with other parasites, in particular *Diplostomum spathaceum*, *Triaenophorus nodulosus*, *Argulus foliaceus*, *Ergasilus sieboldi*, *Raphidascaris acus*, *Bothriocephalus gowkongensis*, *Eustrongylides excisus*. Metacercaria of *P. ovatus* were found in muscular tissue of different species of fish, information are given in table 1.Thus the prevalence of infection varied within the range of 17 (in the pikeperch) to 247 specimens (in roach).

The presence of *P. ovatus* in a large number of fish species indicates the wide ecological plasticity of this pathogen.

P. ovatus was more common in areas of the Southern Bug River in Zhovtnevy, Mykolaiv, Novoodesky Districts; it was less common in Voznesensky, Pervomaysky Districts and the city of Mykolaiv. In the section of the river Inhul, the species was mainly observed in the waters of Bashtansky District. In our opinion, these differences are partly due to the fact that the reservoirs located within settlements are less in habited with main definitive hosts — piscivorous birds. There is also a connection between the spread of paracoenogonimosis and migration routes of birds of passage, which run across some areas of the rivers Southern Bug and Ingul. We believe that sedentary birds that feed on fish play an important role in the maintenance of the infestation causing its outbreak.

Trematode *P. ovatus* has been rapidly spreading over the past 3–4 years, as the analysis of veterinary report documentation in Mykolayiv Region over the past 5 years has not con-

Table 1. Prevalence and intensity of invasion for different species of fish

Species of fish	Prevalence, %	Intensity of invasion, specimens
Roach (*Rutilusrutilus*)	82.3	32–247
Silverbream (*Bliccabjoerkna*)	68.7	21–180
Bream (*Abramisbrama*)	44.0	9–62
Crucian (*Carassius gibelio*)	18.9	1–23
Rudd (*Scardinius erythrophthalmus*)	72.2	17–111
Pike (*Esoxlucius*)	42.3	1–38
Pikeperch (*Sander lucioperca*)	15.3	1–17

firmed the occurrence of paracoenogonimosis in previous years. According to opinion of some researchers, that we also confirm, such helminths as *P. ovatus*, which use certain types of zoobenthos as intermediate hosts, is an indicator of increasing concentration of soluble biogenic elements in the water — eutrophication, due to increase of anthropogenic impact on reservoirs (Novak, 2011).

Conclusion

The analysis of check-out catches in the rivers Southern Bug and Ingul revealed the spread of the paracoenogonimosis which, according to veterinary records, have not been registered in Mykolaiv Region. *P. ovatus* was found in the roach (*Rutilus rutilus*), silver bream (*Blicca bjoerkna*), bream (*Abramis brama*), crucian (*Carassius gibelio*), rudd (*Scardinius erythrophthalmus*), pike (*Esox lucius*), pikeperch (*Sander lucioperca*). The roach was affected in a greater degree, with the prevalence of 82.3 %, the perch was infected in a less degree, with the prevalence of 15.3 %. The intensity of infection was the highest in the roach — up to 247 specimens, the least intensity was in the perchup to17 specimens. The pathogenicity of *P. ovatus* metacercariae is not completely studied and is absent in modern normative documents. Measures of disinfection of fish products are not developed; the danger of infection is still quite high. Fish, especially within unnatural industrial waters, can be a risk factor of humans and animals infection, since it is a vector of potentially dangerous helminths.

References

Bauer, O. N. 1984. *Biological basis of aquaculture: parasites and diseases of fish*. Nauka, Moscow, 1–170 [In Russian].

Bikhovskaya-Pavlovskaya, I. E. 1985. *Parasites of fish: Study Guide*. Nauka, Leningrad, 1–121 [In Russian].

Davidov, O. N., Tymnichanov, Yu. D. 2003. *Diseases of freshwater fish*. Vetinform. Kiev, 1–219 [In Russian].

Henetsinska, T. A., Kosheva, A. F. 1959. On the question of the life cycle and the systematic position of *Paracoenogonimus ovatus* Katsurada (Trematoda) and the identity of this species to *Neodiplostomulum hughesi* Markewitch. *Vestnik Leningradskogo universiteta,* 9, 68–75 [In Russian].

Komiya, J. 1938. Die Entwicklung des Exkretionssystems einiger Trematodenlarven aus Alster und Elbe, nebst Bemerkunden über ihren Entwicklungszyklus. *Z. Parasitenkunde,* **10**, 340–385.

Katszurada, F. 1914. Studien über Trematoden bei Süßwasserfishen, mit besonderer Berücksichtigung der Elb und Alsterfische. *Zbl. Bakteriol., Orig.*, 4–5, 304–314.

Linnik, V. Y. 1988. Parasites of fish. Urodjay, Minsk, 1–80 [In Russian].

Markewitch, A. P. 1951. Parasite fauna of freshwater fish of the Ukrainian SSR. AN USSR, Kiev, 1–357 [In Russian].

Mineeva, O. V. 2013. Parasite fauna of goby *Neogobius iljini* in Saratov Reservoir. *Vestnik Nizhegorodskogo universiteta N. I. Lobachevskogo*, **4** (1), 158–161 [In Russian].

Novak, A. I. Physiological adaptation of fish parasites to environmental characteristics of habitat. *Vestnik RGAU P. A. Kosticheva,* **3** (11), 44–49 [In Russian].

Serbina, E. A. 2002. Mollusk *Bithynia tentaculata* (Gastropoda: Prosobranchia: Bithyniidae) — new intermediate host of *Paracoenogonimus ovatus* (Trematoda: Prohemistomatidae). *Parasitological studies in Siberia and the Far East*. Novosibirsk, 177–180 [In Russian].
Serpunin, G. G. 1997. Biological basis of aquaculture: guidelines for laboratory work in the direction 561100, *Water Bioresources and Aquaculture*. KGTU. Kaliningrad, 1–141 [In Russian].
Sudarikov, V. J., Lomakin, V. V., Atajev, A. M, Semenova, N. N. 2006. *Metacercaria of trematodaes, Parasites of fish in the Caspian Sea and the Volga River Delta*. Nauka, Moskow, 1–183 [In Russian].
Szidat, L. 1936. Parasiten aus Seeschwalben. *I. Z. Parasitenkunde*, **8**, 285–316.

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